International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 6, Issue 4, Aug 2016, 13-18

TRANS STELLAR
•Journal Publications •Research Consultancy

EFFECT OF EDIBLE WAX COATING AND MAP ON THE QUALITY OF MANGO DURING STORAGE

AMULYA P R, SUDHEER K P, RIFNA E J, SREESHA K R & NUSAIBA C

Centre of Excellence in Post Harvest Technology, Department of Food and Agricultural Process Engineering, Kelappaji College of Agricultural Engineering and Technology, Kerala Agricultural University, Tavanur, Kerala, India

ABSTRACT

The effect of edible coating (1% bee wax in rice bran oil) and MAP on shelf life extension of mango fruit (Mangifera indica) was investigated. The physical and biochemical quality parameters such as titrable acidity, TSS, physiological loss in weight, respiration and skin colour were monitored. The analysis was carried out under ambient (26±4ºC, 75±4%) and cold (13±1ºC, 95±2% RH) storage conditions. This study showed that use of edible coating along with MAP condition could reduce the respiration rate and there by extend the shelf life by one to three weeks. From the studies it was able to conclude that bee wax coated mango fruits in combination with MAP condition created by LDPE bags of 210±1 gauge thickness (0% perforation) could store for 20 days in cold storage under set condition with acceptable quality. While the fruits under ambient condition of same treatment lasted only for seven days.

KEYWORDS: Mango, Edible bee wax, LDPE bags

Received: Jun 03, 2016; **Accepted:** Jun 25, 2016; **Published:** Jun 28, 2016; **Paper Id.:** IJASRAUG20164

Original Article

INTRODUCTION

Mangoes (*Mangifera indica*) are an important tropical fruit crop with good potential for expanded markets outside of the growing regions. Mango fruits are climacteric and ripen rapidly after harvest (in about 3 to 9 days). This short period seriously limits the long distance commercial transport of this fruit (Gomer and Lim, 1997). Fruit sensitivity to decay, low temperature and general fruit perishability due to the rapid ripening and softening limits the storage, handling and transport potential. Hence, treatments which would reduce the rate of mango ripening during distribution and allow the development of good quality in ripe fruit could help expand markets for mangoes.CA storage has been shown to extend the shelf life of mango (Bender et al., 2000; Noomhorn and Tiasuwan, 1995) but it is cost prohibitive. So, there is a need to develop cheap and commonly available technology for extending the shelf life of these produce at least to manage the movement in the market change and control the losses.

Modified atmosphere packaging (MAP) can be defined as the enclosure of food in a package in which the atmosphere inside the package is modified or altered to provide an optimum atmosphere for increasing shelf life and maintaining quality of food (Raheem, 2012 ; Robertson, 2006). Passive modification occurs as a consequence of the food's respiration or the metabolism of micro organisms associated with the food; the package structure normally incorporates a polymeric film and so the permeation of gases through the film (which varies depending on the nature of the film and the storage temperature) also influences the composition of

atmosphere that develops (Robertson, 2006).

Edible coatings are used to create a modified atmosphere and to reduce weight loss during transport and storage (Baldwil,1994). Modified atmosphere storage using plastic bags or wrapping has shown some delay in ripening (Nakasone and Paull,1998). Protective films modify the fruit's internal atmosphere and have great potential as shelf life extending treatment for many fruit species (Saftner, 1999; Arjona et al., 1994; Nisperos- Carriedo et al., 1990 ; Kader et al,. 1989 ; Ben Yehoshua,1985). Film treatments function as barriers against water vapour, gases, volatile compounds and ethylene transmissions (Kester and Fennema, 1986).

The objective of the present study was to analyze the suitability of various packaging methods for extending the shelf life of mango. Also to study the effect of edible wax coating in shelf life extension and analyze the post harvest quality parameters of the stored mango.

MATERIALS AND METHODS

Mangoes (*Mangifera indica*), which belong to the variety Moovandan were brought from Iritty, Kannur district. They were harvested four days before starting the treatments. The mangoes were washed with distilled water and cleaned.

The mangoes were divided into two groups at random for either ambient storage (26±4ºC, 75±4%) or cold storage (13±1ºC, 95±2% RH). The fruits were mature and weighing an average of 200 g each. The mangoes under the above two storage conditions were given eight different treatments namely: Treatment 1- samples were packed in low density poly ethylene (LDPE) bags of 210±1 gauge thickness. Treatment 2- samples were packed in intelligent package (IP) of 200 gauge. Treatment 3- samples were shrink wrapped. Treatment 4- samples were wax coated and packed in LDPE. Treatment 5- samples were wax coated and packed in IP. Treatment 6- samples were wax coated and shrink wrapped. Treatment 7- samples were wax coated. Treatment 8- samples were kept under controlled condition.

Bee wax, a natural wax produced by honey bees were used. Since the bee wax cannot be used as such, a formulation of bee wax with rice bran oil was made. The wax coating with wax to oil ratio 1:100 (Alfiya et.al, 2010) was used.

Physiological Measurements

Respiration is measured by O_2/CO_2 head space gas analyser PBI Dansensor (Checkmate 2) gas analyser. Total soluble solids (TSS) were determined using a portable refractometer. The results were expressed in degree Brix. For acidity, pH was measured directly on the pulp and titrable acidity (TA) was determined by titration with NaOH and expressed as percentage of citric acid per 10 ml of mango pulp. The moisture content was determined by oven drying method. Known weight of samples (10 g) were kept inside a hot oven at a temperature of 90ºC.

The PLW was calculated according to the method of Thakur et al. (2002). For determining the PLW of fruits were weighed immediately after imposing the treatment which served as the initial fruit weight. The loss in weight was recorded at regular interval until the product was spoiled, which served as the final weight.

The degree of greenness and yellowness were recorded by observing manually according to a colour score as given below.

- Green

- More green less yellow
- Half green half yellow
- More yellow less green
- Yellow
- Yellow with black spots

RESULTS AND DISCUSSIONS

Preliminary experiments under ambient and cold conditions showed that all treatments reduced the respiratory rate of the fruit while increasing the shelf-life from 3 to 6 days and 4 to 10 days respectively compared with the control sample.

Respiration

Respiration (measured as CO_2 liberated) was suppressed in treated fruits compared to untreated ones. Mangoes of treatments T1, T4 and T6 exhibited less classical climacteric respiratory peak while mangoes under rest of the treatment showed climacteric peak at 13th day of cold storage. Among all the treatments, T4 (wax + LDPE) showed the best result. The suppression of respiration was likely due to the modification of the internal atmosphere of the fruit (decreasing O_2 and increasing CO_2) caused by the semi permeable characteristics of the coatings to these gases (Banks 1984). Similar results were found for strawberry (El Ghaouth et al. 1991), tomato (El Ghaouth et al. 1992), mango (Joseph and Aworth, 1992), and pear (Sumnu and Bayindirli 1994).

At ambient condition also treatment 4 (ie; wax coating and MAP), showed the least respiration rate after seventh day of storage.

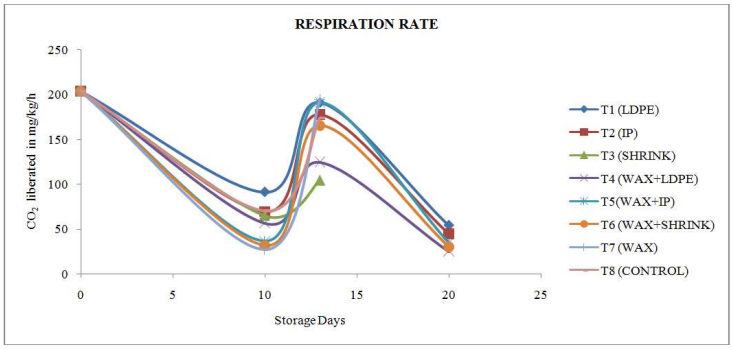

Figure 1: Changes in Respiration Rate of Mangoes during Storage Period

Physiological Loss in Weight (PLW)

Treatment 4 was the most effective for retarding weight loss. After 20 days of simulated cold storage, mangoes treated with treatment 4 showed only a weight loss of 3.8 g. In contrast, fruits treated under treatments 2 and 7 exhibited high weight loss levels. The reason for the reduction in weight loss may be due to the blockage of lenticels and/or stomates (Dhalla and Hanson 1988) as evidenced by the reduction in respiration and gas exchange (Hagenmaier and Baker 1993). Edible bee wax is hydrophobic and thus presents a good barrier to water vapour. Similar result was obtained in passion fruit (Madhana S R et al, 2014).

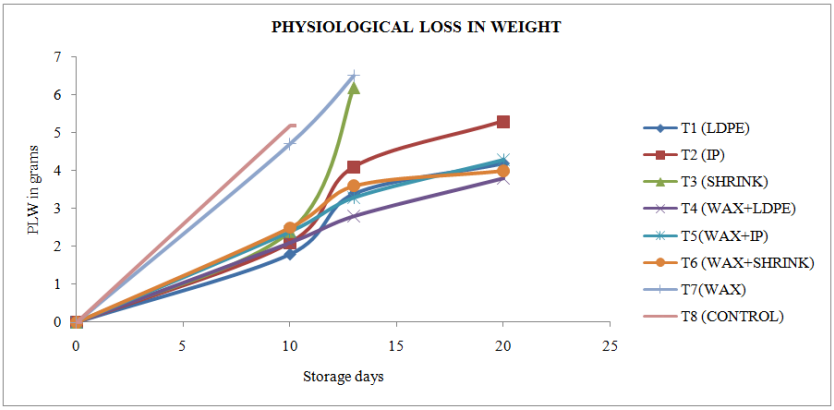

Figure 2: Changes in Physiological Loss in Weight during Storage Period

Total Soluble Solids (TSS)

There was a general increase in the values of TSS for all the treatments. The increase in TSS concentration during the storage period may be due to the increased respiration rate and the transit of fruits towards ripening. However, TSS were significantly lower in treatment T4 with a value of 15^{o}brix even after the 20th day of cold storage. The lowest TSS may be attributed to retarded respiration due to the combined effect of LDPE and wax coating.

In ambient condition, treatments T4 and T7 showed the least value of TSS reading 13.5 and 14.2^{o}brix respectively at the seventh day of storage.

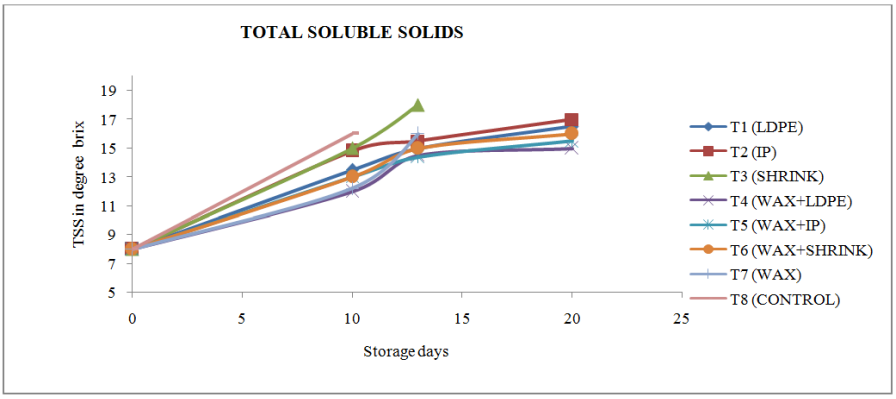

Figure 3: Changes in Total Soluble Solids during Storage Period

Acidity

The TA values of all the treatments showed a significant decrease of about 90 % compared to the initial values of the storage. Similar results were obtained in cucumber (Nunes et al, 2011; Hima et al,2014).This decrease may be due to the increased respiration rate and starch hydrolysis. However on the 20th day of cold storage a slight hike (0.0576% citric acid) in the TA was observed in the treatment T4. This is due to the delayed ripening in wax coated LDPE package.

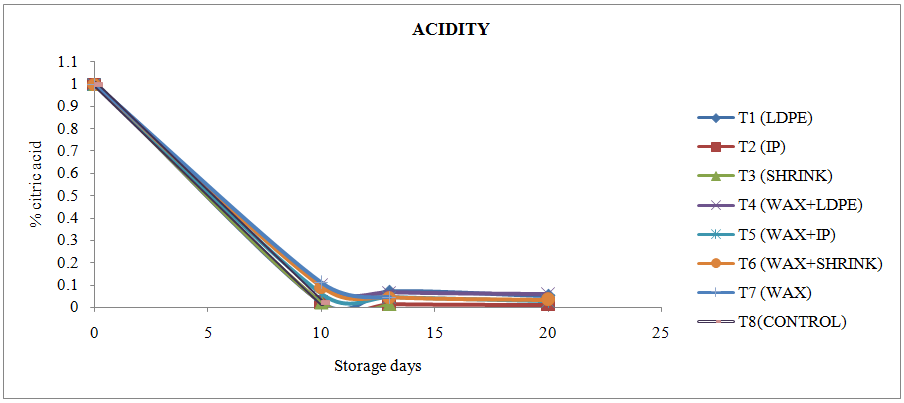

Figure 4: Changes in Acidity during Storage Period

Moisture Content

In general the mangoes show a decreasing trend in moisture content with storage irrespective of the treatment. In contrast it was observed that the percentage of moisture content got increased in all wax coated treatments of which maximum moisture content was observed in treatments T4 and T5 with 89% after the 20th day of cold storage. This might be due to the restricted metabolic activity of wax coated mangoes at MAP created by non perforated LDPE and IP bags.

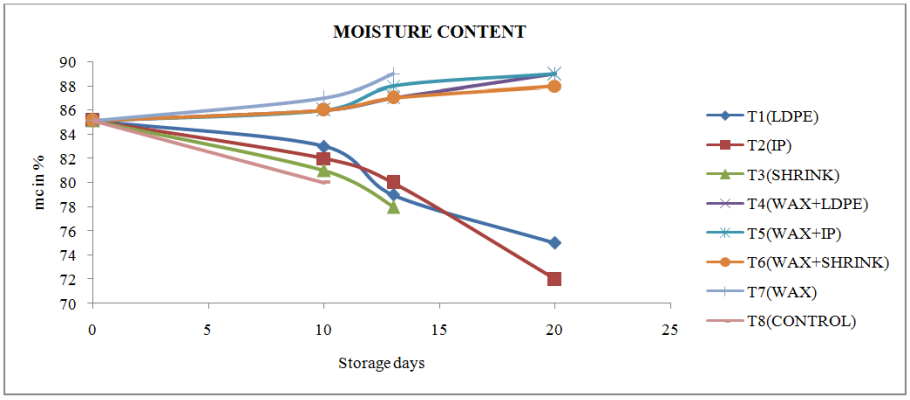

Figure 5: Changes in Moisture Content during Storage Period

Colour

The development of fruit color is influenced by the internal gas environment (Buescher, 1979) including levels of CO_2 and ethylene. Elevated CO_2 concentration inhibits ethylene synthesis which, in turn, influences chlorophyll breakdown. Low levels of O_2 also inhibits ethylene production (Medlicott et al. 1987).

A significant change in colour was observed during the storage period of mangoes. Black spots were observed on treatments T2, T3, T6, T7 and T8 at ht end of 20th day of cold storage. The best result was obtained for the treatment T4 with a colour score of 4, that is more yellow less green.

In ambient storage condition, a colour score of 2 was observed for treatment T1 which was the best among other treatments at the end of seventh day of storage.

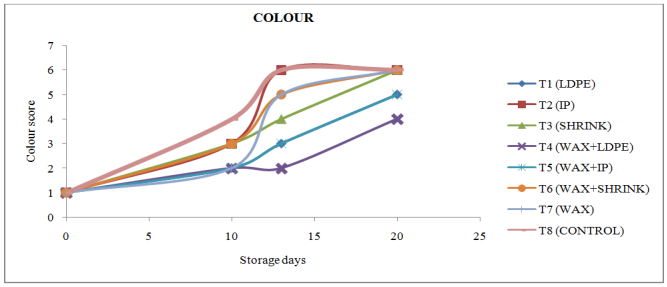

Figure 6: Changes in Fruit Colour during Storage Period

CONCLUSIONS

In conclusion, all seven treatments limited the respiratory rate of mangoes during storage, and delayed ripening compared to control at both ambient and cold storage conditions. From the studies it was able to conclude that bee wax coated mango fruits in combination with MAP condition created by LDPE bags of 210 ± 1 gauge thickness (0% perforation) could store the Cv 'Moovandan' for 20 day in cold storage under set condition with acceptable quality. While the fruits stored under ambient condition of the same treatment lasted only for seven days. The results showed that the edible wax coating (bee wax emulsified with rice bran oil and standardized in the ratio 1:100) in combination with MAP bags created by LDPE bags under low temperature storage is a beneficial treatment for extending the shelf life of mango.

REFERENCES

1. *Baldwin, E. A. (1994). Edible coatings for fresh fruits and vegetables: past, present, and future. In Edible Coating and Films to Improve Food Quality, 25-64, Technomic Publishing Co., Lancaster, PA.*
2. *Bender, R. J., & Brecht, J. K. (1995). Inhibition of ethylene production in mango fruit by elevated co, and recovery during subsequent air storage. Proc. Fla. State Hort. Soc. 108, 279-285.*
3. *Dalal, V.B. & Eipeson, W.E.(1971). Wax emulsion for fresh fruits and vegetables to extend their storage life. Indian Food Packer 25, 9-11.*
4. *Medlicott, A.P., et al. (1987). Effect of ethylene and acetylene on mango fruit ripening. J. Appl. Biol. 111, 439-444.*
5. *Miller,W.R., et al. (1983). Quality and decay of mango fruit wrapped in heat shrinkable film. Hort Science 18,957-958.*
6. *Noomhorm, A., & Tiasuwan, N. (1995). Controlled atmosphere storage of mango fruit. J. Food Processing Preservation 19, 27-28.*
7. *Serrano, E.P. (2005). Postharvest management of fruit and vegetables in the Asia-Pacific region: Philippines country report. Asian Productivity Organization (APO); Food and Agriculture Organization of the United Nations (FAO). APO and FAO, Japan, Rome, pp. 216–226.*
8. *Subramanjam, H., & Krishnamurthy, S. (1975). Physiology and biochemistry of mango fruit. Adv. Food Res., 21: 223-305.*
9. *Gregory Mccolum T.(1992). Individual shrink film wrapping of mangoes.Proc.Fla.State.Hort.Soc.105,103-105.*
10. *Hoa. T.T., et al.(2001). Effect of Different Coating Treatments on the Quality of Mango Fruit. Journal of Food Quality. 25(3) :471-481*
11. *Thompson, A.K. (1971).The storage of mango fruits. Trop. Agr.(Trindad), 48(1): 63-70.*
12. *Yam, K. L., et al.(2005). Intelligent packaging: concepts and applications. Journal of Food Science. 70: R1-R10*